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Lyle A. Derscheid
South Dakota State University

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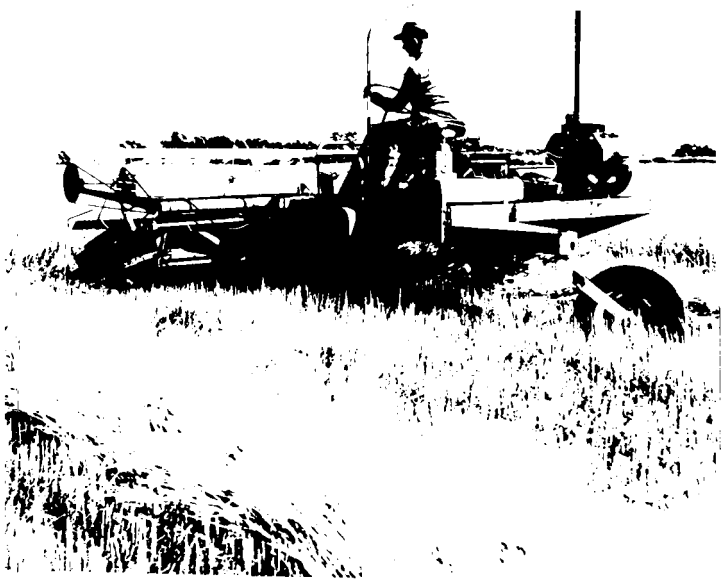

COOPERATIVE EXTENSION SERVICE
SOUTH DAKOTA STATE UNIVERSITY
U.S. DEPARTMENT OF AGRICULTURE

SMALL GRAINS FOR FORAGE

Lyle A. Derscheid, Extension agronomist*

The idea of small grains for forage—pasture, hay, haylage, silage, and greenchop—gains more attention every year.

Interest is particularly high in the central and north-central areas of South Dakota. In these predominantly spring grain areas, harvesting small grain for forage prevents wild oats from going to seed—a major step in its control.

Small grains are better adapted to areas with low spring subsoil moisture and/or low mid-summer rainfall than are long-season crops such as corn or sorghum.

Another reason for interest in small grains as forage is that production costs are lower for small grain. Oats, the best example of this, provides protein cheaper than any other crop except alfalfa, and it produces energy (TDN) and dry matter (DM) at lower cost than any other crop for much of the state.

Though small grains may be relatively economical forage crops for beef or milk production, the removal of the straw has the same long-range deleterious effects on soil productivity as other annual crops that are harvested for forage.

Pasture

Winter wheat and rye are excellent crops for fall or spring pasture. Though winter rye generally produces more forage, either crop can be seeded in July for fall grazing. Both make excellent early spring pasture if seeded in late August or early September. Under good growing conditions, these crops can be moderately grazed, in some parts of the state, for 3 weeks in early spring and still produce a grain crop. Spring-seeded grains can be seeded late to provide summer pasture. They may be equal to millet for this purpose, but are seldom as productive as sudangrass. Early planted spring grains can be used as pasture during June in years when spring growth of perennial grasses is later than normal.

In drought years small grain may contain a toxic amount of nitrates. Ruminant animals convert nitrates to nitrites which "tie up" the hemoglobin in the blood. The blood cannot carry oxygen and the animal suffocates. Forage can be tested in the agricultural biochemistry laboratories at SDSU for nitrate content.

If the forage contains more than 0.15% nitrates it should be mixed with other forage. This is difficult to do in pasture, but relatively easy to do with harvested forage.

Harvested Forage

Any small grain raised in South Dakota may be harvested for forage. You can handle forage in at least three different ways. You can cut the crop and allow it to dry in the field until the moisture percentage is reduced to about 12%. It is then handled as hay. Small grain may be cut and stored almost immediately in a silo (pit, bunker or upright), and handled as silage. The third type of forage is cut and allowed to dry until the moisture percentage drops to 45 to 55%. Alfalfa handled in this manner is called "haylage" or "low moisture silage," and oats is sometimes called "oatlage". We could use the term "wheatlage" for wheat, but to avoid manufacturing "lage" words for rye, barley or triticale; we use the terms "oatlage" or "oat haylage" for oats and "haylage" for other crops.

The major difference among the three types of forage is moisture percentage. Though moisture percentage varies for each type of forage, the calculations in this publication are based on the following: 12% for hay, 50% for haylage, and 67% for silage. Since DM content of forage is more important, the following discussions refer to DM differences rather than moisture differences—hay contains 88% DM, haylage 50%, and silage 33%. All nutrient percentages are given for a moisture free or DM basis. Therefore, an oat crop that produces 2.82 T/A DM will produce 3.2 T of hay, 5.6 T of oatlage (haylage) or 8.5 T of silage.

The nutrient content of the crop changes during the growing season, but it is fixed at harvest time. The amount of protein or energy in the plants, when harvested, will not change materially except for slight differences in harvesting and storage losses. Therefore an oatlage crop yielding 2.82 T/A of DM with 9.7% protein and 59% TDN contains 547 lb/A protein and 3,328 lb/A of TDN regardless of whether it produces 3.2 T/A of hay or 8.5 T/A of silage. However, nutrients are lost if forage is lost during harvest and/or storage.

Harvesting losses for most forages increase as moisture content decreases, but the reverse is true for storage losses. Frequently the high harvesting losses and low storage losses for hay give a total loss equal to the low harvesting losses and high storage losses from silage. With alfalfa haylage, the losses from both harvesting and storage are low, and the total loss is somewhat less than that for either hay or silage. This may not be true for small grain haylage, especially if it is stored in an open silo or pile.

In one test at Brookings the DM yield was 6.7 % greater for oat haylage (48.7% DM) than for oat hay (87.3% DM), indicating that harvesting losses were 6.5 to 7.0% greater than for hay. Storage losses were 2.3% for the hay and 11.7% for the haylage stored in a concrete stave silo. There was 3.6% less DM for feed from haylage.

Good silage can be made from small grain, but it is more difficult than with corn or sorghum because of the hollow stems. For best forage and maximum protein, small grain should be cut when in the late milk to early dough stage. At this stage, the growing crop generally contains 80 to 85% moisture and should be allowed to dry until it loses 15 to 20% moisture. Under drought conditions the forage can be picked up immediately after cutting. Under average weather conditions it should be left in the windrow 2 or 3 hours on hot, dry days and up to 24 hours on cool, humid days. Since windrowing can be done much faster than chopping, it is not advisable to windrow more grain at one time than can be chopped in one day. If an entire field is windrowed, it may be too dry before the chopper can get to it. Fine chopping (½- to ¾-inch cut) and thorough packing are essential.

Good small grain haylage is extremely difficult to obtain, because the hollow small grain stems do not pack easily. It is almost impossible to pack small grain forage tightly enough to exclude oxygen in an open pit or bunker silo if the forage contains less than about 60% moisture. If the oxygen is not excluded spoilage losses occur. Good small grain haylage can be obtained if it is stored in an oxygen-limiting silo.

Small grain that is allowed to mature until moisture content is down to 60% loses leaves, causing reduced forage yield and much lower protein percentage. Rough awns of some bearded varieties are more apt to cause problems. On the other hand, small grain silage with moisture content of above 70% produces "sour" feed that is unpalatable.

Even though good silage can be made, well packed silage sometimes "sets up" and can be difficult to handle at feeding time. This is especially true of silage that contains too much moisture.

Comparison of Small Grains

Oats has the advantage of being awnless or beardless. Rough awns on older barley varieties reduced the palatability of that crop and sometimes caused other problems. Most of the present-day varieties have smooth awns and are less objectionable. Some of the most popular standard hard red spring wheat varieties are beardless and make good forage. The bearded wheat varieties have shorter beards than barley which gives them an advantage over barley. Most semi-dwarf spring wheat varieties have beards, but their forage yield may be too low to warrant using them for forage anyway.

Triticale has long, rough awns which are objectionable. In 1975 one rancher near Mobridge who fed triticale silage to beef cattle found that the beards caused abscesses to form in the jaws of many of

his cattle. It was necessary to have a veterinarian lance the jaws to drain the infection. Several animals died and others had low rates of gain.

Winter wheat, durum, and winter rye varieties have relatively long beards. They are less desirable for harvested forage than either oats or beardless wheat.

Data from Fargo (Table 1) indicate that oats, barley, and spring wheat produce similar yields of forage at several stages of growth. Oats may have a slight advantage over the other crops if cut at the milk stage of growth. Semi-dwarf wheat varieties were not tested, but they probably do not produce as much forage as the taller varieties used in the Fargo test. In one comparison near Selby, two varieties of triticale produced 1.1 and 1.3 T/A DM while Burnett oats produced 1.4 T/A. At Brookings, oats yielded 3.33 T/A while a oats-barley-wheat mixture yielded 3.56 T.

Though oats has some advantages and is more commonly used than other small grains, it also accumulates more nitrates than barley or wheat. Some cattlemen report that oats forage sometimes causes abortion. The nitrates may have this effect on pregnant cows, but we are not aware of any other ill effects.

As small grain plants develop, the production of DM increases (Table 1) and the protein content decreases (Figure 1).

Table 1. Tons of dry matter per acre from small grain harvested at various stages of growth

Stage of Growth	Fargo (3-year avg)			Redfield (1974)
	HRS wheat	barley	oats	10 oat varieties (avg)
Tiller	0.21	0.41	0.27	—
Jointing	0.67	0.99	0.77	—
Early boot	1.42	1.86	1.49	—
Milk	2.73	2.62	3.30	2.9
Dough	3.72	3.86	3.91	3.3
Mature	3.28	3.78	3.71	—

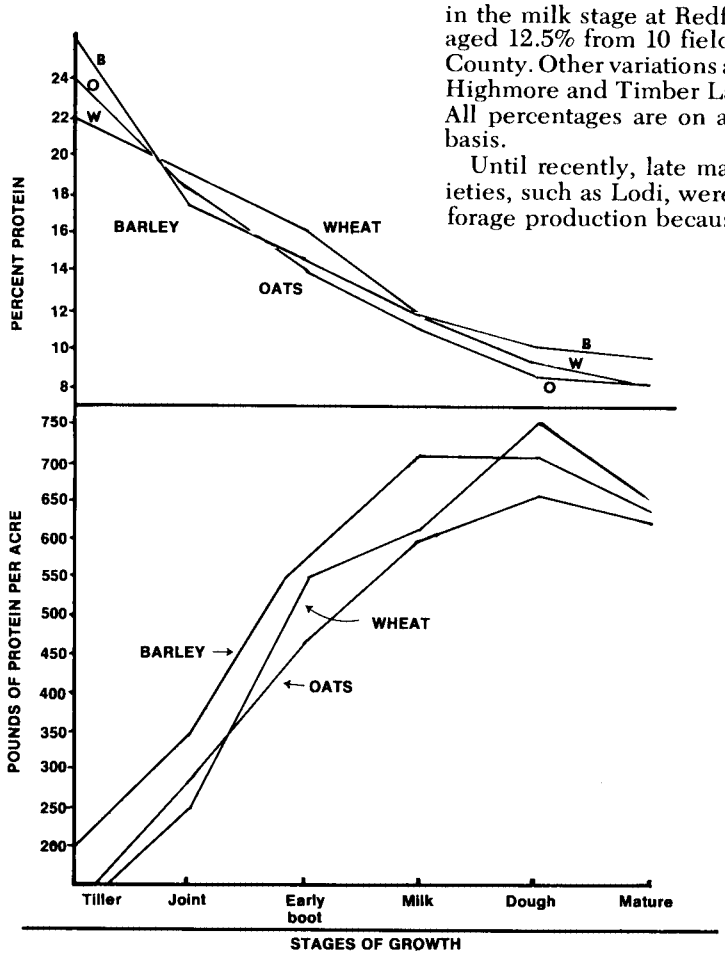

Figure 1. Percent protein (DM basis) and pounds of protein per acre from small grains harvested at six stages of growth at Fargo (3 years).

Yield of DM for oats, barley, and wheat peaks when the grain is in the dough stage. Protein yield for both barley and wheat peaks at the same time; however, oats reaches its high point when the grain is in the milk stage. The amount of protein in the crop at harvest time is essentially the amount that will be in unspoiled forage at feeding time.

Oats For Forage

Protein content of oats varies from year to year and location to location. At Fargo (Figure 1) protein content of oats in the late milk to early dough stage was between 10.8 and 8.4%, which is comparable to 9.6% obtained in a Wisconsin survey. South Dakota tests indicate that protein content of oats forage ranged from 10.8 to 12.4% for four varieties harvested in the milk stage at Redfield, and averaged 12.5% from 10 fields in Walworth County. Other variations are reported for Highmore and Timber Lake in Table 2. All percentages are on a moisture free basis.

Until recently, late maturing oat varieties, such as Lodi, were suggested for forage production because they usually had more straw than earlier varieties. However, variety comparisons made at several locations indicate forage production is not related to date of maturity. At Beresford, for example, two early and two mid-season varieties produced the most DM (Table 2). At Redfield an early variety was high producer, but late varieties ranked first at Selby and Timber Lake.

It appears that most people will want to plant a variety that will produce a good grain crop. They don't have to make a decision until mid-June on whether to harvest for grain or forage. Since small grain maturity moves from the milk stage to the hard dough stage in a few days, the crop may be in the milk stage when harvesting operations begin, but be past the dough stage by the time a large harvesting operation is completed. This problem can be partially offset by planting two or more varieties of different maturity. For example, large operators might consider the use of an early variety such as Nodaway 70 or Diana, a mid-season variety like Burnett, Chief or Spear, and a late variety such as Dal, Froker, Lodi or Wright.

Oats vs Other Forage Crops

Oats compares favorably with several other annual crops for yield of forage, nutrient content, feed value and cost of production.

Yield, Protein and TDN

In eastern South Dakota, oats produces as much forage as other short-season annuals, but not as much as long-season crops. In central South Dakota oats forage production equals that of long-season crops.

At Brookings in 1961, a year of slightly above average rainfall (21.36 inches April-August), Garry oats produced as much DM (Table 3) as Piper sudangrass and a sudan-soybean mixture (with a thin stand of beans), more DM than German millet, but not as much as the sorghum-sudan hybrid, two forage sorghum hybrids, or corn. Oats contained 59% TDN, which was more than sudangrass or millet and almost as much as the other crops. At the Southeast Research Farm near Beresford, 17 oat varieties produced an average of 3.2 T/A of air dry material in 1974, a year with a dry spring. This yield is below that of several other crops (Table 3) grown in 20- and 40-inch rows during 1962, a year with normal rainfall following a dry year.

During 1974, oats produced an average of 1.54 T/A DM on four Potter County farms while corn produced 1.63 T. The oatlage contained 11.7% crude protein on a moisture free basis and 51% TDN, while the corn contained 9.8% protein and 64.5% TDN. At the Pasture Research Center in Faulk County, corn produced am average of about 6 T/A of silage (2 T/A DM) while alfalfa produced an average of 1.2 T/A of hay (1.06 T/A DM) over an 8-year period.

During 1974, oats produced an average yield of 2 T/A of oatlage (about 1 T/A DM) on 10 Walworth County farms and 1 T/A of hay (about 0.9 T/A DM) in 20 fields. Alfalfa produced an average of 1.1 T/A of hay (about 0.97 T/A DM) in 40 fields. The oats hay and haylage contained an average of 11.6% protein on a moisture free basis while the alfalfa hay contained 16%. Corn silage from 31 fields averaged 10%.

Table 2. Tons of dry matter* per acre from several oat varieties at several locations

Variety**	Beresford (1974)	Redfield (1974)	Highmore (1973) Yield	Highmore (1973) % Protein	Selby (1975)	Timber Lake (1972) Yield	Timber Lake (1972) % Protein
Grundy	2.76	—	—	—	—	1.88	7.9
E72 or 74	2.73	—	—	—	—	1.80	7.3
Nodaway 70	3.19	—	—	—	—	1.95	8.2
Trio	2.84	3.08	—	—	—	2.22	8.3
Diana	3.19	3.52	—	—	—	2.03	8.4
Otee	2.70	—	—	—	—	—	—
Noble	2.45	—	—	—	1.50	—	—
Burnett	2.94	3.17	—	—	1.40	1.84	8.8
Kota	—	—	—	—	—	1.98	7.0
Spear	2.87	—	—	—	1.36	—	—
Chief	2.35	3.08	—	—	1.28	2.13	9.1
M72 or 74	3.40	3.08	—	—	—	1.88	7.3
Garland	2.45	—	—	—	—	—	—
Holden	3.47	—	—	—	1.40	2.36	8.4
Portal	2.59	2.90	2.3	10.9	1.43	2.15	7.0
Dal	2.70	3.08	2.2	10.7	1.07	2.69	7.5
Froker	2.87	3.17	2.3	11.4	—	1.90	7.8
Kelsey	—	3.08	2.3	11.2	1.78	2.07	6.6
Random	—	—	—	—	1.43	2.18	—
Astro	—	—	—	—	—	—	—
Cayuse	2.49	—	1.9	12.3	—	—	—
Lodi	—	—	2.0	10.3	—	1.96	7.5
Mammoth	—	—	2.1	12.0	—	2.36	7.7
DM average	2.82	2.81	2.17	11.4	1.29	2.08	7.34
Hay (88% DM)	3.2	3.2	2.5	10.0	1.5	2.4	6.5
Haylage(50% DM)	5.6	5.6	4.3	5.7	2.6	4.2	3.7
Silage (33% DM)	8.5	8.5	6.6	3.7	3.9	6.3	2.4

* To determine yields of hay, haylage, or silage: divide tons of DM by percent DM in hay, haylage, and silage (2.82 ÷ 0.88 = 3.2 etc.).
** Varieties listed according to date of maturity, early varieties listed first.

Table 3. Tons of dry matter per acre from several forage crops grown at Brookings in 1961 and Beresford in 1962

Crop	Brookings* T/A DM**	Brookings* TDN %***	Brookings* TDN T/A	Beresford* T/A** (air dry) 20-inch	Beresford* T/A** (air dry) 40-inch
Oats	5.2	59	3.1	3.2 ('74)	—
German millet	4.9	56	2.8	—	—
Piper sudan	5.2	56	2.9	4.3	4.3
Sudan-soybean mix	5.2	60	3.1	4.4	5.0
Sudan hybrid	—	—	—	7.4	7.1
Sorghum-sudan hybrid	8.7	60	5.2	7.1	6.6
Forage sorghum varieties	—	—	—	6.8	5.6
Forage sorghum hybrids	7.0	60	4.2	7.6	6.7
Corn	7.5	66	4.2	6.9	6.3

* Rainfall above normal at Brookings; normal at Beresford in 1962 following the dry year in 1961. 1974 had about 70% of normal during April to June at Beresford.
** To determine yields of hay, haylage, or silage: divide tons of DM by percent dry matter in hay, haylage, and silage.
*** Moisture free basis

Table 4. Comparison of two oat forages (two periods in one experiment) and corn silage (separate experiment) for beef steers

	680-lb Hereford steers* Oat hay 12.7% moisture	680-lb Hereford steers* Oatlage 51.3% moisture	525-lb steers Corn Silage 67% moisture
Number of days	91	91	85
Daily consumption			
Lb forage (as fed)	27.0	43.0	33.0
Lb forage (DM)	24.7	23.6	20.8
Lb SBO meal**(as fed)	—	—	2.0
Average daily gain	2.1	3.0	2.35
Number of days	129	134	—
Daily consumption			
Lb forage (as fed)	27.9	46.5	—
Lb forage (DM)	24.6	24.7	—
Average daily gain	1.8	2.28	2.35
Feed efficiency	13.9	10.8	9.7

* Results given for first 91 days (comparable to 85 days for corn silage) and for the entire length of experiment.
** soybean oil meal

Table 5. Comparison of two small grain forages and a hypothetical corn silage ration for dairy cows and heifers

	Oatlage 55% moisture	OBW* 62% moisture	Hypothetical corn silage ration 67% moisture
Holstein cows			
Daily consumption			
Lb forage (as fed)	47.5	59.3	65.0
Lb forage (DM)	21.4	22.5	21.5
Lb alfalfa hay (DM)	5.8	5.9	5.9
Lb concentrate (DM)	15.4	15.4	15.4
LB SBO meal**(as fed)	—	—	0.52
Gain in body weight	0.81	0.94	—
Lb/day milk	43.8	43.7	43.7
Holstein Heifers			
Daily consumption			
Lb forage (as fed)	29.9	36.3	41.2
Lb forage (DM)	13.4	13.8	13.6
Lb corn-oats mix (as fed)	4.0	4.0	—
Lb SBO meal** (as fed)	—	—	1.9
Average daily gain	2.24	2.31	2.24-2.31

* Oats-barley-wheat mixture
** Soybean oil meal

Comparative Nutritive Value

Oat forage is comparable to other forages for both beef and milk production. It ordinarily requires less supplementation with protein, but more energy supplementation than corn.

Two experiments conducted in the Animal Science Department at SDSU

indicate the relative value of oat forage and corn silage. In one test, 525-lb steers were fed corn silage and soybean oil meal for 85 days. The results are given in Table 4. In the other trial one 14-steer group, averaging 680 pounds, was fed oat hay and a similar group was fed oat haylage, both without supplementation. The data (Table 4) indicate that gains obtained the first 91 days were better for oatlage than for corn silage supplemented with soybean oil meal for a similar length of time. At the end of the oat forage experiment the average daily gain from oatlage was not quite as high as from corn silage and the feed efficiency was slightly higher. The oatlage produced 16% more gain per ton of DM than the oat hay. When differences in yield were considered the net gain was 24% higher for haylage than for hay.

Two experiments conducted in the Dairy Science Department at SDSU compared oatlage (13.1% crude protein) with an oats-barley-wheat (OBW) forage mixture (14.2% crude protein) for milk production from Holstein cows and body weight gain for the cows and Holstein heifers.

In the first experiment, each 10-cow group was fed an oats-corn-urea concentrate and alfalfa hay. The results (Table 4) indicate that milk production is similar to that expected of a hypothetical ration of corn silage, alfalfa hay, a 50-50 corn-oats concentrate and soybean oil meal.

The two 10-heifer groups of 591-lb animals received a 38-62 corn-oats concentrate, salt and minerals. The results (Table 5) indicate that the two rations were comparable to a hypothetical ration of corn silage and soybean oil meal.

National Research Council (NRC) values for several forages are given in Table 6. The values are for a moisture free basis and represent an average value for each crop (on DM basis) whether handled as hay, haylage or silage. The protein content for small grain forages is higher than for row crops, but lower than for hay crops, while the reverse is true with respect to TDN.

Table 6. National Research Council values* for nutritive content (DM basis) of good quality forage from several crops

Forage	Protein %	TDN** %	Phosphorus %	Calcium %
Small grain				
Oats	9.7	59	0.30	0.37
Barley	8.9	67	0.28	0.22
Wheat	8.7	64	0.26	0.44
Row crops				
Corn	8.5	70	0.21	0.28
Forage sorghum	8.4	64	0.20	0.40
Grain sorghum	7.1	61	0.21	0.40
Hay crops				
Alfalfa	15.0	48	0.28	2.01
Alfalfa-brome	14.0	55	0.26	1.03
Sudan	12.7	59	0.31	0.56
Native	7.5	50	0.15	0.38

* Based on DM; they are same for hay, haylage or silage.
** for cattle.

Relative Costs

Estimated cost of production of DM, crude protein, and TDN are given in Table 7. The percentage crude protein and TDN in Table 6 were used to estimate yield of these nutrients. The forage yields were estimated by using data from research and demonstration plots in each of the areas.

Forage production costs are divided into "costs of production" and "land charges." Production costs include costs of seed, seedbed preparation, planting, fertilizer, herbicides, insecticides, harvesting, storing, and feeding. Land charges are 6% (0.75% for taxes and 5.25% for return on investment) of indicated land values and are listed separately for those who do not wish to use our estimates. It is realized that costs, yields, protein, and TDN content will vary for each operator. These estimates are intended to be an average for the area represented.

If you wish to use your own costs of production and feeding, your own forage yields or the protein content or TDN percentage of your feed, you can calculate your own costs with the following formulas:

1. cost per ton = cost per acre ÷ tons per acre
2. cost per ton DM = cost per ton ÷ DM percentage
3. cost per 100 pound of protein = cost per ton DM ÷ percent protein ÷ 20
4. cost per 100 pound of TDN = cost per ton DM ÷ percent TDN ÷ 20

Example: calculations for corn silage at Beresford.

1. production cost per ton = $256.20 ÷ 14 = $18.30
   land charges per ton = $36.00 ÷ 14 = $2.57
   total cost per ton = $18.30 + $2.57 = $20.87
2. production cost per ton DM = $18.30 ÷ 0.33 DM = $55.45
   land charges per ton DM = $2.57 ÷0.33 DM = $7.79
   total costs per ton DM = $55.45 + $7.79 = $63.24
3. total cost per 100 lb of CP = $63.24 ÷ 0.085 (Table 6) = $744 ÷ 20 = $37.20
4. total cost per 100 lb of TDN = $63.24 ÷ 0.70 (Table 6) = $90.34 ÷ 20 = $4.52

Other Considerations

When small grain straw or other crop residue is removed, it takes nutrients from the soil which must be replaced by fertilizers to maintain yields in subsequent years. Straw from an 80-bushel oat crop contains about 80 lb of potassium, 8 lb each of calcium and magnesium, 0.03 lb of copper and 0.29 lb of zinc—4 to 5 times the amount contained in the grain. While nitrogen and phosphorus are the important nutrients at the present time, continuous removal of residues may eventually cause deficiencies of some o the minor elements. More important removal of crop residues reduces soil or ganic matter (OM).

Harvesting an 80-bushel oat crop fo forage removes about 2 tons of stra which would decompose into more tha 200 pounds of humus. Humus become OM that can be replaced by manure an green manure crops, but it may be neces sary to plow down several alfalfa o sweetclover hay crops to replace the OM removed by a few years of harvestin small grain for forage.

Though OM contains all the soil n trogen and half the available phos phorus, OM is more important for main taining good soil tilth. OM causes ag gregation of soil particles. The pore among soil aggregates keep the soil ope so it will absorb and hold a maximur amount of rainfall, hold runoff to minimum, and reduce wind erosion. I also reduces power cost for tillage opera tions. See Fact Sheet 655 "Do You Reall Want to Remove Crop Residues?" fo more details on the long-term value c straw or residue for crop production.

Table 7. Estimated costs - production and land charges - of harvested forage, dry matter (DM), crude protein (CP), and total digestible nutrients (TDN) of several forages for several areas of South Dakota.

	Yield	Forage Production Costs* and Land Charges**						Total Costs		
		Per Acre		Per Ton		Per Ton DM		Per	100 lb	100 lb
	T/A	Prod.	Land	Prod.	Land	Prod.	Land	Ton DM	CP	TDN
South East Research Farm - Beresford Land Value $600/A										
Alfalfa hay (baled)	3.2	$59.75	$36.00	$18.65	$11.25	$21.20	$12.70	$23.90	$11.35	$3.54
Alfalfa haylage (50% DM)	5.1	83.00	36.00	16.30	7.05	32.55	14.10	46.65	15.55	4.86
Oat silage (33% DM)	8.5	134.30	36.00	15.80	4.25	47.80	12.85	60.75	31.30	5.44
Corn silage (33% DM)	14.0	256.20	36.00	18.30	2.55	55.45	7.80	63.25	37.20	4.52
Forage sorghum silage (33% DM)	15.0	249.00	36.00	16.60	2.40	50.30	7.30	57.60	32.30	4.50
Agronomy Farm - Brookings Land Value $500/A										
Alfalfa hay (baled)	2.6	$50.00	$30.00	$19.25	$11.55	$21.85	$13.10	$34.95	$11.65	$3.64
Alfalfa haylage (50% DM)	4.2	69.60	30.00	16.60	7.15	33.15	14.30	47.45	15.80	4.94
Oat silage (33% DM)	8.5	131.25	30.00	15.45	3.55	46.80	10.70	57.50	29.65	4.87
Corn silage (33% DM)	10.0	190.00	30.00	19.00	3.00	57.60	9.10	66.70	39.20	4.76
Forage sorghum silage (33% DM)	12.0	213.15	30.00	17.75	2.50	52.85	7.55	60.40	35.95	4.72
James Valley Research Center - Redfield Land Value $300/A ($200 for native hay)										
Native hay (loose)	1.0	$22.60	$12.00	$20.55	$10.95	$23.35	$34.25	$57.60	$38.40	$5.76
Alfalfa hay (baled)	1.5	29.20	18.00	19.45	12.00	22.10	13.65	35.75	11.90	3.72
Alfalfa haylage (50% DM)	2.9	47.80	18.00	16.50	6.20	32.95	12.40	45.35	15.10	4.73
Oat silage (33% DM)	8.0	125.20	18.00	15.65	2.25	47.40	6.80	54.20	27.95	4.60
Corn silage (33% DM)	8.0	161.05	18.00	20.15	2.25	61.00	6.80	67.80	39.90	4.84
Forage sorghum silage (33% DM)	9.0	172.40	18.00	19.15	2.00	58.05	6.00	64.10	38.15	5.01
Pasture Research Center - Norbeck Land Value $225/A ($150 for native hay)										
Native hay (loose)	0.5	$ 7.25	$ 9.00	$14.50	$18.00	$15.40	$20.45	$35.85	$23.90	$3.58
Alfalfa hay (loose)	1.2	27.30	13.50	22.75	11.25	25.85	12.80	38.65	12.90	4.02
Alfalfa haylage (50% DM)	1.9	33.20	13.50	17.45	7.10	34.90	14.20	49.10	16.35	5.12
Oat silage (33% DM)	6.6	107.50	13.50	16.30	2.05	49.35	6.20	55.55	28.65	4.71
Corn silage (33% DM)	6.0	124.30	13.50	20.70	2.25	62.80	6.80	69.60	40.90	4.96
Forage sorghum silage (33% DM)	7.0	137.95	13.50	29.65	1.95	89.80	5.85	95.65	56.90	7.47
Dewey County - Timber Lake Land Value $175/A ($75 for native hay)										
Native hay (loose)	0.4	$ 5.80	$ 4.50	$14.50	$11.25	$16.50	$12.78	$29.25	$19.50	$2.93
Alfalfa hay (loose)	1.0	14.05	10.50	14.05	10.50	15.95	11.95	27.90	9.30	2.90
Alfalfa haylage (50% DM)	1.6	23.75	10.50	14.85	6.55	29.70	13.15	42.85	14.30	2.17
Oat silage (33% DM)	6.3	24.40	10.50	3.85	1.65	11.75	5.05	16.80	8.65	1.42
Corn silage (33% DM)	4.0	93.30	10.50	23.30	2.65	70.70	7.95	78.65	46.25	5.62
Forage sorghum silage (33% DM)	4.0	94.80	10.50	23.70	2.65	71.80	7.95	79.75	47.50	6.23

* Production costs include stand establishment, production, harvesting, storing, and feeding. Harvesting, storing, and feeding costs estimated to be $12.25 per ton for large round bales of baled hay, alfalfa haylage, and oat silage; $14.00 per ton for corn and sorghum silage; and $14.50 per ton of loose hay (many hay harvesting costs are fixed on acre basis and low yields raise costs per ton). Stand establishment of alfalfa pro-rated for 3 years at Beresford, 5 years at Brookings, and 8 years at other locations.

** Land charges are 6% of indicated land values.

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